

Comments Received from L&D HWG as of 19 June 2000 on Fuel Tank Documents Submitted to TAEIG

Note: each member of the L&D HWG was provided the opportunity to comment on the WG report, NPRM and AC. Each was given 4 options:

- A. I have no comments and I accept the document as written.
- B. I object to the document going forward, for reasons given in the attached comments.
- C. I can accept the document, but suggest improvements in the attached comments.
- D. I do not fully agree with the document for reasons given in the attached comments, but I agree not to object to the proposal.

All responders selected A except for the following who had additional comments and thus selected "C" - I can accept the document, but suggest improvements in the attached comments. **The one exception is Boeing. They have selected "B" - I object to the document going forward, for reasons given in the attached comments.** Boeing comments are at the end of this document.

1. WG Report

a) Christian Beaufils – Airbus Industrie

PROPOSED WG report for 25.561,25.721,25.963 & 25.994

Airbus comments on draft dated 13 June 2000-06-16

The following improvements are proposed, as indicated in bold.

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed?

The JAA has an ACJ 25.963(d) to require additional items under a broad interpretation of JAR 25.963(d) and JAR 25.721. In addition Certification Review Items have been used to provide additional criteria. **Recognizing that the local fuel head has been used in the past to justify crash capabilities of fuel tanks, JAA issued an interim policy in 1991 (INT/POL/25/9) allowing such an interpretation, in replacement of ACJ 25.963(d).**

The FAA has imposed fuel inertia loading condition on tailplane tanks outside the fuselage contour by use of a Special Condition:

Tailplane Tank Emergency Landing Loads. In addition to the requirements of § 25.963(d), the following applies;

- (a) The tailplane tank in the horizontal stabilizer must be able to resist rupture and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in § 25.561.

(b) For the side load condition the quantity of fuel need not exceed 85 percent when determining pressure loads outside the fuselage contour for the 3g lateral direction.

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in?:

The main difference derives from JAR Paragraph 25.963(d) and the interpretations for 25.963(d) in ACJ 25.963(d) and INT/POL/25/9.

ACJ 25.963(d) and INT/POL/25/9 provide that the tanks outside the fuselage but inboard of the landing gear, or adjacent to the most outboard engine support the support the emergency landing loads of 25.561. ~~All tanks outside the fuselage contour are assumed to be 85 percent full.~~

ACJ 25.963(d) and INT/POL/25/9 also provide that fuel tank installations should be such that the tanks will not be ruptured by the airplane sliding with its landing gear retracted, nor an engine mounting tearing away.

4 - What, if any, are the differences in the current means of compliance?

ACJ 25.963(d), INT/POL/25/9 and a JAA Certification review items provide the means of compliance with 25.963(d) and also impacts 25.721 and 25.994. This includes fuel inertia loading for tanks outside the fuselage contour, considerations of sliding on the runway with combinations of landing gear not extended, additional landing gear breakaway criteria, and conditions of nacelles breaking away.

In compliance with the ACJ interpretation of JAR 25.963(d), prior issuance of INT/POL/25/9, the US manufacturers have used a chordwise head to determine fuel pressure under emergency landing load factors. The European manufacturers have used 85 percent of the maximum permissible volume

7 - How does this proposed standard address the underlying safety issue (identified under #1)?

- The proposed change to 25.561 would ensure fuel tanks and lines would be protected from cargo shifting in the cargo compartment under emergency landing condition.

8 - Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain.

An increase in the level of safety because it adds fuel tank pressure load criteria to fuel tanks outside the fuselage contour, provides additional break-away criteria for nacelles, and a requirement to consider a wheels-up landing condition including the fuel tank heating in case of fuel tank scraping action with the ground.

17. - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

Advisory Circular AC 25-783-1A 963-2 is submitted with full consensus of the working group (LCH note - this has been corrected in copy submitted to TAEIG)

C.Beaufils. (Airbus)
16 June 2000

b) Jack Grabowski - Transport Canada

To: Larry Hanson/SAV/GAC@GAC
cc:

Subject RE: Fuel Tank Sign -Off

Larry,

I will be signing all three sign-off sheets as C (with comments). My comments are in the nitpicking category - wording, typos etc. I think that we should be careful with the phrases 'minor crash', 'wheels up' and where they are used since there are already existing definitions for the above and the additional uses implied may cause confusion. The comments below are placed under the three topics that we are signing for even though they may be repetitious.

Working Group Report.

Question 6 Item 2. Amend Section 25.721.....

(b) The airplane must be designed to avoid any rupture leading to the spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway under the following minor crash landing conditions:

Question 6 Item 4. Amend Section 25.994.....

Fuel system to constitute a fire hazard as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in 25.721(b).

Justification for removal: 25.721 specifies more than a simple 'wheels-up' condition

Question 7 Bullet 6.

A decent descent rate of 5 fps for the minor crash landing condition is established for the purposes of protecting fuel tanks in emergency landing conditions.

Question 7 Bullet 10.

The minor crash landing conditions is clarified for section 25.994 are clarified by referencing 25.721(b).

Question 17

Advisory Circular 25.783-1 addresses doors etc, Surely this is an incorrect reference. (LCH Note: this has been corrected in the AC submittal to TAEIG)

Question 20

The answer 'Yes' is ambiguous since there are two questions asked and no explanation provided.

2. NPRM

a) Christian Beaufils Airbus- Industrie

Proposed NPRM for 25.561,25.721,25.963 & 25.944

Airbus comments on draft dated 31 May 2000

The following improvement is proposed:

Add 'unless the landing gear configuration is shown to be extremely improbable' at end of sentences from 25.721(b)(1) and (b)(2).

Rationale:

The issue is about protection of fuel tanks against risk of fuel spillage which could lead to a fire hazard, in abnormal landing conditions where none or only some of the landing gear legs are extended.

The 5fps 'minor crash landing condition' prescribed in 25.721(b), with the proposed AC 25.963-2 interpretation, has been agreed by the LDHWH as one acceptable requirement condition to address this issue.

Airbus confirms agreement with this prescribed condition but emphasizes that this should be only ONE way, and we should not exclude for future a/c an alternative which would increase the level of safety compared with current standards. This alternative would be to design the landing gear systems so that all or some gear-up configurations would be extremely improbable, thus avoiding the landing gear configurations which could lead to risk of fuel spillage at landing.

This would lead to an increase of the a/c level of safety as instead of relying on a 'simplistic' 5fps minor crash condition, as proposed in 25.721(b), the landing gear configuration would be avoided.

Without such an alternative in the rule, there will be no incentive to promote such design improvement in the future.

C.Beaufils (Airbus)
16 June 2000

b) Jack Grabowski - Transport Canada

To: Larry Hanson/SAV/GAC@GAC
cc:

Subject: RE: Fuel Tank Sign -Off

Larry,

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Draft NPRM under Proposed Amendments.

3. To amend Section 25.721 to read as follows:

(b) The airplane as a result of a wheels-up landing on a paved runway under the following minor crash landing conditions:

(1) *****

(2) *****

(c) for configurations where so that when it fails failure occurs due to overloads

4. To amend Section 25.963

(d) (4) Fuel tank installationsor landing gear, tearing away separating as specified in 25.721(a) and (c).

5. To amend Section 25.994 to read as follows:

Fuel systems components as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in 25.721(b).

3. AC

a) Christian Beaufils Airbus – Industrie

Proposed AC on 'Fuel Tank Strength in Emergency Landing Conditions'

Airbus comments on draft dated 31 May 2000

The following improvement is proposed.

§ 4(b) (I) and (ii)

Add ' unless the landing gear configuration is shown to be extremely improbable' within these paragraphs, in line with the proposed change for 25.721(b)(1) and (b)(2).

Rationale: see comments to NPRM

§ 4(b) (i)

It is better to keep the last sentence as agreed in Munich :

'Considering the fuel tank arrangement, a reasonable aircraft attitude and speed within the speed range from VL to 1.25 VL2 should be selected'.

§ 4(b)(iv)

It is not clear when the analysis should stop, in case of pylon/engine mounts failure. As the engine/pylon trajectory analysis is not required after engine/pylon separation, it seems illogical to go beyond this point in time.

Therefore, it is proposed to add the following sentence:

' The assessment of secondary impacts of the airframe with the ground following engine/pylon separation is not required.'

C.Beaufils (Airbus)

16 June 2000

b) Jack Grebowski - Transport Canada

To: Larry Hanson/SAV/GAC@GAC

cc:

Subject RE: Fuel Tank Sign -Off

Larry,

I will be signing all three sign-off sheets as C (with comments). My comments are in the nitpicking category - wording, typos etc. I think that we should be careful with the phrases 'minor crash', 'wheels up' and where they are used since there are already existing definitions for the above and the additional uses implied may cause confusion. The comments below are placed under the three topics that we are signing for even though they may be repetitious.

Draft AC under Section 4 GENERAL.

(b) Protection against crushing

Each fuel tank should be protected with the ground under the following minor crash landing conditions

(b)(iv) and (c) appear to cover the same general area although (c) refers to overload specifically. Therefore, use (b)(iv) for the situation where separation does not occur.

(iv) For aircraft with wing mounted engines, if failure of engine mounts, pylon or its attachments to the wing occurs without separation during the impact or sliding phases, the subsequent effect on the integrity of the fuel tanks in the associated wing structure should be assessed.

(c) Engine/Pylon Separation (Compliance with 25.721(c) and 25.963(d)(4).

For configurations where the nacelle/powerplant is likely to come in contact with the ground, failure under overload should be assessed. Consideration should be given to the separation of the engine nacelle (or nacelle + pylon) from its supporting structure under predominantly upward loads and predominantly aft loads acting separately. It should be shown that, at separation, the fuel tanks in that supporting structure are not ruptured at or near the engine/pylon attachments. Trajectory analysis of the engine/pylon subsequent to separation is not required.

c) Tony Linsdell – Bombardier Aerospace

To: Larry Hanson/SAV/GAC@GAC
cc: al064591@eng.canadair.ca

Subject: Fuel Tank Sign-off

Larry,

Comment on proposed AC 25.963-2
"FUEL TANK STRENGTH IN EMERGENCY LANDING CONDIOTIONS"

The AC is a very good document.

However the last sentence in para 4.b.(i) might lead to a variety of interpretations. I propose 1 additional sentence to help clarification.

In para 4.b.(i) I propose to add the following to the end of the paragraph,

" For example, a reasonable attitude would be as described in the wheels-up-landing procedure in the aircraft flight manual."

regards

Tony Linsdell
Bombardier Aerospace

d) Abe Jibril - Learjet

See suggested change in last sentence below:

b. Protection against crushing and scraping action (Compliance with 25.963(d)(3) and 25.721(b) and (c))
Each fuel tank should be protected against the effects of crushing and scraping action (including thermal effects) of the fuel tank and surrounding airframe structure with the ground under the following minor crash landing conditions:

- (i) An impact at 5 fps vertical velocity on a paved runway at maximum landing weight, with all landing gears retracted and in any other possible combination of gear legs not extended. The unbalanced pitching and rolling moments due to the ground reactions are assumed to be reacted by inertia and by immediate pilot control action consistent with the aircraft under control until other structure strikes the ground. It should be shown that the loads generated by the primary and subsequent impacts are not of a sufficient level to rupture the tank. A **reasonable normal landing attitude** should be selected within the speed range from V_{L1} to $1.25 V_{L2}$. ~~based upon the fuel tank arrangement.~~

4) General comments

a) Michael Lischke - DASA

DASA Comments on Fuel Tanks draft WG report, NPRM and AC for 25.561, 25.721, 25.963, 25.944

From: Michael Lischke - DASA

To: Larry Hanson - Gulfstream

Larry,

of course the design of an airplane should avoid a fire hazard after a landing gear system failure as mentioned in 25.721.

The discussion about landing gear failures leads directly to the question of the probability of such a failure, as we discussed very intensively at the last WG meeting in Munich.

From my point of view this is in line with the 25.302 which talks about the probability of system failures in general.

Therefore the WG report, NPRM and AC should be limited to conditions **not extremely improbable**.

Michael Lischke
DASA
16.06.2000

b) Wim Doeland - JAA / RLD

To: Larry Hanson/SAV/GAC@GAC
cc: "Andrew Goudie" <andrew.goudie@srg.caa.co.uk>, "Christophe Vuillot"
<vuillot_christophe@sfact.dgac.fr>

Subject: Submittals to TAEIG

Larry,

On Fuel Tank Crashworthiness (25.721/25.963) it's JAA position that we could accept the rules and advisory material as currently drafted by the L&DHWG. However, we also feel that the quality of the proposed advisory material (i.e. on the minor crash conditions to be considered) may benefit from further discussions by the L&DHWG.

Wim Doeland

c) Michael Green - Boeing

AVIATION RULEMAKING ADVISORY COMMITTEE

LOADS AND DYNAMICS HARMONIZATION WORKING GROUP

RECORD OF TECHNICAL CONSULTATION

Date 13 June 2000

PROPOSED NPRM FOR 25.561,25.721, 25.963, &25.944 Draft Dated: 31 May 2000

TITLE: Revised Requirements for Structural Integrity of Fuel Tanks

The referenced NPRM has been issued for consultation, and reviewed both at and subsequent to the Munich meeting.

In the opinion of the Chairman this document is ready for final acceptance.

As a member of the L&D HWG, please sign below, along with indicating the company that you represent plus a selection of a category from A through D below.

- A. I have no comments and I accept the NPRM as written.
- B. I object to the NPRM going forward, for reasons given in the attached comments.
- C. I can accept the NPRM, but suggest improvements in the attached comments.
- D. I do not fully agree with the NPRM for reasons given in the attached comments, but I agree not to object to the proposal.

Name	Signature	Company	Category A-D
Michael A. Green comments)		Boeing	B (see attached

AVIATION RULEMAKING ADVISORY COMMITTEE
LOADS AND DYNAMICS HARMONIZATION WORKING GROUP
RECORD OF TECHNICAL CONSULTATION
Date 13 June 2000

PROPOSED AC

DATE OF DRAFT: 31 May 2000

AC NUMBER: 25.963-2

TITLE: **Fuel Tank Strength In Emergency Landing Conditions**

The referenced AC has been issued for consultation, and reviewed both at and subsequent to the Munich meeting. In the opinion of the Chairman this document is ready for final acceptance.

As a member of the L&D HWG, please sign below, along with indicating the company that you represent plus a selection of a category from A through D below.

- A. I have no comments and I accept the AC as written.
- B. I object to the AC going forward, for reasons given in the attached comments.
- C. I can accept the AC, but suggest improvements in the attached comments.
- D. I do not fully agree with the AC for reasons given in the attached comments, but I agree not to object to the proposal.

<u>Name</u>	<u>Signature</u>	<u>Company</u>	<u>Category A-D</u>
Michael A. Green (see attached comments)		Boeing	B

PROPOSED NPRM AND AC FOR 25.561, 25.721, 25.963, & 25.944 Draft Dated: 31 May 2000**Boeing Comments**

The NPRM and AC being proposed are a more rigid interpretation of current requirements that do not recognize nor allow for the continuation of previous good design practices, and imply costly and extensive analyses in order to satisfy these requirements.

The proposed NPRM requires a wheels up landing analysis with a descent rate of 5 feet per second (fps). While we agree that requirements for protection of fuel tanks are necessary, the strict application of a 5-fps wheels up landing scenario may go beyond the intent of the proposed rule. It is clear that the proposed rule is not intended to address a safety problem in the existing fleet, but rather to clarify the existing requirements, eliminate the use of special conditions and certification review items, and maintain an existing level of safety for future designs. The current requirements for fuel tank protection do not specify a descent rate for the wheels up condition. Five feet per second has, in the past, appeared in paragraph 25.561(b)(3)(iv) as an alternate means of determining the downward minor crash landing load factors only (the 5 fps alternative was removed at Amendment 64). Five feet per second descent rate for wheels up landing has never been a specific requirement. The requirement for protection of fuel tanks during minor crash landings has been levied by Certification Review Items on Boeing airplanes, where the 5 fps descent rate has been specified as "an acceptable interpretation", not as the only means of compliance. The accepted means of compliance has been to maintain and demonstrate equivalent levels of safety by continuing with design features that have a proven safety record. The Boeing fleet, through extensive fleet history, has a proven design philosophy providing robustness between safe separation of nacelles and fuel tank protection for wheels up landing. The Boeing design philosophy does not specifically include an analysis at 5 fps descent speed, but instead includes a qualitative assessment of the design that ensures an equivalent level of safety with existing proven designs.

The proposed AC provides a means of compliance that implies detailed analyses of specific wheels up landing and sliding scenarios. While tools exist which may be used to simulate these complex scenarios, we are not confident in the design implications or the cost impacts of such analyses. There are no alternate means of compliance discussed which would allow for demonstration of good design practice based on extensive fleet history and proven design techniques.

Therefore, we feel that the proposals, without further investigation of analysis techniques and allowances for design practices, should not go forward at this time.